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A Review of the Wildfire Problem in Kentucky Tobacco

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CONTENTS

Page

Habits and Relationships of the Wildfire and Angular Leaf Spot Organisms 3

Outbreaks of Wildfire in 1950 and 1951 4

Value of Bluestone-Lime Treatment 5

Permanent Plant Bed Sites 7

Recommendations for the Control of Wildfire and Angular Leaf Spot 8

A Review of the Wildfire Problem In Kentucky Tobacco

By W. D. Valleau and Joseph L. Troutman

During the past two seasons (1950 and 1951) wildfire has been unusually prevalent in tobacco plant beds in Kentucky and neighboring states. Methods of prevention which have hitherto been considered satisfactory were used successfully by many growers, while other growers using these methods failed to prevent the disease, probably because they applied bluestone-lime too late.

The outbreaks of wildfire are remarkable because until relatively recently wildfire was almost unknown to the vast majority of tobacco farmers. It was first recognized in Kentucky in 1920, when it caused injury in some plant beds and fields. By 1936 the disease could be found in several of the southern counties in the western part of the state and was found occasionally in other parts of the state. During the period from 1920 to 1936 angular leaf spot, or rust, which we now know to be closely related to wildfire, was a common disease in burley tobacco beds everywhere the crop was grown in the state. Angular leaf spot is not so conspicuous as wildfire in dark tobacco and so was not commonly recognized in dark tobacco beds. Between 1936 and 1939 these bacterial diseases were studied in Todd and neighboring counties by E. M. Johnson. During this period, wildfire and angular leaf spot were found in about equal amounts in 62 percent of the steamed beds and 73 percent of the burned beds that were not treated with bluestone-lime. 1/ Sometimes one, sometimes the other, and frequently both diseases were in the same bed. Since 1939 wildfire has generally been on the increase and angular leaf spot on the decrease.

At present wildfire seems to be prevalent everywhere, while even in burley tobacco angular leaf spot is only occasionally seen. There has been a remarkable change from the twenties, when angular leaf spot was common and wildfire rare, to the present when wildfire is everywhere and angular leaf spot rare.

HABITS AND RELATIONSHIPS OF THE WILDFIRE AND ANGULAR LEAF SPOT ORGANISMS

The organisms that cause these diseases are bacterial and probably are strains or phases of a single species. In the laboratory, single-cell cultures of the wildfire organism have been known to change either to a strain of wildfire that produces very little of the toxin that causes the large yellow spots, or to the typical angular leaf spot organism. Likewise, in the laboratory, single-cell cultures of the angular leaf spot organism have changed to the wildfire organism. Something of the same kind appears to have occurred in nature on a massive scale during the past few years. What the conditions are that have caused the change from the non-toxin-producing angular leaf spot organism to the toxin-producing wildfire organism we do not know.

For many years these organisms were considered to be primarily pathogens of tobacco and to be in some way dependent upon tobacco for their existence. It is now known that the natural habitat of both organisms is on the surface of live roots of tobacco, wheat, rye, barley, and many annual and perennial pasture plants and weeds. Apparently enough nutrients are extruded from the roots to maintain the bacterial colonies. Because of this habit of growth it is easily understood why the diseases are so prevalent in tobacco beds during wet periods, as the majority

1/ 3-3-50 bordeaux mixture.

of beds are prepared by turning under some form of vegetation in the spring and partially sterlizing the soil by burning wood over the surface. The heat penetrates only a shallow layer of soil and the roots and organisms remain active below the heated layer.

OUTBREAKS OF WILDFIRE IN 1950 AND 1951

When it was realized that there was an exceptionally severe outbreak of wildfire in 1950, an attempt was made to determine the kind of plant bed preparation most likely to result in wildfire-free beds. As the survey progressed it appeared that spring-plowed beds were more likely to be infected that fall-plowed beds, although there were exceptions. Fall-plowed, well-steamed beds seemed to be entirely free from infection except where water from the surrounding area drained across the beds.

During the plant-bed season of 1951 a total of 44,090 running feet (over 8 miles) of beds 12 feet wide were examined for the presence of wildfire. All but 5,700 feet--one-third of which was spring-plowed and the remainder fall-plowed--had been treated with bluestone-lime. Of the spring-plowed beds, 56.5 percent had wildfire, while 28.9 percent of fall-plowed beds were infected. 1/ If these figures are broken down further it will be seen that of the fall-plowed beds those steamed (23.4 percent infected) and those gassed (29.4 percent infected) were freer from wildfire than the burned beds (47.3 percent infected). 2/

Of the beds treated with bluestone-lime, fall-plowed steamed beds had only 9.2 percent infection, fall-plowed methyl-bromide-treated beds had 12.7 percent infection, while fall-plowed burned beds had 44.1 percent infection (Table 1). Spring-plowed steamed beds (thoroughly steamed) had no wildfire, while 58.6 percent of spring-plowed burned beds were infected. Thus under average farm conditions, with bluestone-lime frequently applied too late to be effective, the order of plant-bed preparation, so far as wildfire control is concerned, is fall plowing and steaming, fall plowing and gassing, fall plowing and burning, and spring plowing and burning--the latter beds having the most wildfire.

VALUE OF BLUESTONE-LIME TREATMENT

The figures just given on the amount of infection in beds treated with bluestone-lime raise a question as to the value of this treatment in preventing wildfire in plant beds. There is also the theoretical consideration that fall-prepared beds should not carry the bacteria over winter, provided the crop turned under is completely killed and the roots partially decayed before cold weather sets in. Fortunately, a considerable amount of detailed evidence bearing on these points was collected by E. M. Johnson, in Todd and neighboring counties, between 1936 and 1939. Records were made on whether the plant beds were steamed or burned, and on the presence or absence of wildfire or angular leaf spot in the beds. He also

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1/ Percent of beds infected, wherever used in this paper, is based on the number of 100 by 12 foot beds that showed infection. Sometimes there was only a small infected area in the bed, so that actually the extent of control was usually much greater than is indicated by the figure.

2/ These figures do not include extensive fall-plowed beds on two farms where the same beds have been used year after year.

Table 1.--Wildfire infection in spring-plowed and in fall-plowed beds treated and untreated with bluestone-lime, 1951

	Treated with bluestone-lime			Not treated with bluestone-lime		
	Infected	Uninfected	% infection	Infected	Uninfected	% infection
	linear ft	linear ft		linear ft	linear ft	
Spring-plowed beds						
Steamed	0	1,150	0	0	0	0
Burned	7,600	5,400	58.6	1,400	400	77.7
Methyl bromide	....	.....	....	.....	...	....
Cynamide	....	.....	....	.....	...	....
Fall-plowed beds						
Steamed	1,100	10,800	9.2	2,000	0	100
Burned	2,840	3,600	44.1	0	400	0
Methyl bromide	700	4,800	12.7	1,300	0	100
Cynamide	0	400	0	.....	...	....

treated a large number of beds with bluestone-lime at the proper time and recorded the results.

During the 4 years, over 6 miles of steamed beds, 9 to 12 feet wide, not treated with bluestone-lime, were inspected. Over 4 miles of these beds, or 62.5 percent, were infected to a greater or less extent by wildfire or angular leaf spot, or both, while slightly over 2 miles were free from infection (Table 2). Unfortunately the time of steaming was not recorded except in a few instances, but in an area where so many beds are steamed much of it must have been done in the winter and early spring. There is no way of determining, therefore, whether early fall steaming was more effective in eliminating the organism than winter steaming when the ground is cooler, more likely to be wet, and consequently less likely to be as thoroughly steamed as fall-steamed beds. The figures indicate clearly, however, that steaming in itself is not sufficient to guarantee wildfire-free beds.

The results on untreated burned beds also are given in Table 2. Of a total of 2.8 miles of beds inspected, 72.6 percent were infected with wildfire, angular leaf spot, or both, while the remainder were not affected. Burning, as would be expected, is less effective in eliminating the wildfire organism than steaming.

Failure of steaming to eliminate the organism from the seedbed soil may be explained in one of two ways. The bed may have become recontaminated, after the plants were up, by water washing over the bed, or steaming may have been inadequate to penetrate a sufficient depth to kill all roots and bacteria on them particularly when done during the winter. Burning, as usually done, penetrates only a short distance and is inadequate to kill either the roots or the organisms to a sufficient depth.

During the 4 years' study in Todd county, 277 farm beds were treated with bluestone-lime by or under the direct supervision of Dr. Johnson. Of the treated beds 7 had a trace of wildfire and 4 a trace of angular leaf spot. Some of the affected beds were treated later than they should have been, so infection may al-

Table 2. --Wildfire and angular leaf spot in plant beds not treated with bluestone-lime, 1936-39

Year	Affected (linear feet)	Not affected (linear feet)	Percent affected
Steamed beds			
1936	3,700	6,300	37.0
1937	9,900	2,550	79.5
1938	2,150	100	95.5
1939	5,700	3,900	59.4
Total	21,450	12,850	62.5
Burned beds			
1936	1,700	2,750	38.7
1937	950	0	100.0
1938	100	0	100.0
1939	5,900	500	92.2
Total	8,650	3,250	72.6

ready have occurred before treatment. These results indicate that bluestone-lime treatment is highly effective in preventing wildfire and angular leaf spot in the plant bed, provided it is applied when the plants are very small and the work is thoroughly done. A comparison of these results (treatment properly applied and control almost perfect) with the results of the 1951 survey of beds treated by farmers, where as high as 58 percent of the beds were affected, suggests that something is radically wrong with the way the control practices are carried out.

In the 1950 and 1951 survey there appeared to be at least four obvious explanations for infection in treated beds: (1) that water flowing through the vegetation surrounding the beds had picked up the wildfire organism and carried it into beds that were not properly ditched; (2) that bluestone-lime had been applied to the bed after infection had occurred (it takes about 4 or 5 days after infection for the disease to cause obvious symptoms); (3) that the surface coating of bluestone-lime had been broken in weeding and bacteria had been carried to the surface; and (4) that in beds recently plowed and lightly burned the bacteria on roots of plants turned under may have been washed during heavy rains to the surface of the tobacco leaves, which they entered without coming in contact with the copper. There is little doubt that the high percentage of infection in treated beds during these 2 years was due to one or another of these causes, but particularly to late application. For the bluestone-lime treatment to be effective, the ground should be thoroughly covered before infection takes place, and this can only be done when the plants are very small and do not yet nearly begin to cover the ground. Most growers have been treating their beds after the plants are the size of a dime or a quarter, in spite of annual warning that treatment should be applied when the plants are very small.

PERMANENT PLANT BED SITES

In the past the Experiment Station has recommended the use of new plant bed sites each year, at first because of the greater chance of black root rot in beds previously used. With the development of root-rot-resistant varieties this was no longer necessary for burley beds, but still is of importance with dark tobaccos un-

less the beds are thoroughly steamed. After 1937, when root-rot-resistant burley varieties were generally available, the recommendation was continued because of the chance of carry-over of blue mold from one season to the next. It has now become evident that blue mold carry-over is important in only an occasional year; for periods of several years it may be disregarded. Consequently a few growers as well as the Experiment Station have been using permanent plant bed sites for several years, with marked success in raising good plants free from wildfire. The beds are disked and sown to soybeans as soon as setting is finished. In the fall the beds are plowed and steamed, treated with methyl bromide, or burned. In the spring bluestone-lime is applied when the plants are just above ground, again a few days later, and sometimes a third application after weeding. On one farm this practice has been followed for several years on from 9,000 running feet of bed 12 feet wide to two or three times that amount. Neither wildfire nor angular leaf spot has been found in the beds managed this way, although the diseases have been found in new beds on the same farm and in tobacco set in the field and rained on heavily for several days. In 1951 a 100-foot bed in this area was left untreated with bluestone-lime and was not affected by wildfire, suggesting that this system may keep the beds completely free of the organisms.

On another farm, under different management, about 2,800 feet of bed 12 feet wide is prepared each year. In 1950 about half of the beds were in a permanent location and handled as described above. In this bed area wildfire or angular leaf spot has been found in several years. An equal amount of bed was prepared in the spring of 1950 in an area where plants had been grown before but the area had grown up to weeds and was plowed in the spring and burned. Although treated with bluestone-lime, wildfire developed in a few places in these beds, and in the field in plants set from these beds. The 1951 beds in this area were fall-plowed and steamed and were completely free from wildfire.

Though it might not seem significant for three bed areas to be free from wildfire in one year, yet the large size of these bed areas and their freedom from these diseases year after year, while nearly all other tobacco beds in the region had some wildfire in both 1950 and 1951, would make it appear that the practices followed were effective in eliminating the bacteria from the bed areas, with consequent complete control. Theoretically, beds handled as these have been should be free from wildfire whether treated with bluestone-lime or not. The most probable explanation for complete control year after year in the permanent beds is that fall plowing of soybeans results in a bed free from living roots, particularly if the bed is partially sterilized by heat or gas, and the bacteria consequently have no way of surviving the winter. These beds were well enough ditched to prevent appreciable recontamination from water washing through surrounding vegetation and over the bed.

RECOMMENDATIONS FOR THE CONTROL OF WILDFIRE AND ANGULAR LEAF SPOT

Wildfire and angular leaf spot are caused by bacteria that normally live on the roots of pasture plants and weeds. In the absence of roots the bacteria disappear from the soil. The bacteria may be picked up by water flowing through grass and weeds and cause infection if the water flows through a tobacco bed. Therefore, beds should be located preferably on a slight southern slope and extend down the slope so that water can be kept from overflowing the beds.

Early fall plowing of new bed sites will give an opportunity for all plants turned under to decay before cold weather. If beds are burned, gassed, chemically treated, or steamed in the fall the roots are still more likely to be destroyed and the soil come through the winter free from the wildfire bacteria. Spring-plowed beds are almost certain to be contaminated by the wildfire bacteria unless they are thoroughly steamed. Burning, as it is usually done, is not sufficient to kill the roots of the plants turned under or the bacteria on them.

While in the past it has been recommended that a new bed site be used each year, the advantages of a permanent bed site appear to outweigh the disadvantages. A plant bed, if located in a desirable place, should be disked and sown to soybeans after setting is complete. In the fall the beans should be plowed or disked and the bed treated for weed control. This practice has given wildfire-free beds where it has been extensively tried, provided the beds are ditched so that water from the surrounding area will not flow over them, and they are treated with bluestone-lime while the plants are very small.

In the spring, as soon as the tobacco plants can be seen, they should be treated with bluestone-lime, and again a few days later. Failure of bluestone-lime to prevent wildfire is probably in great part the result of applying it too late.

Caution: There is a question as to whether permanent plant bed sites should be established in areas where black shank is prevalent, unless the grower is equipped to steam the bed area thoroughly each year or is equipped to gas with methyl bromide. There is too great a chance for beds to become contaminated with the black shank fungus and the fungus carried on young plants to clean fields.

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